pA@RHIC Workshop, 2013

Feasibility and Challenges of pA Collisions

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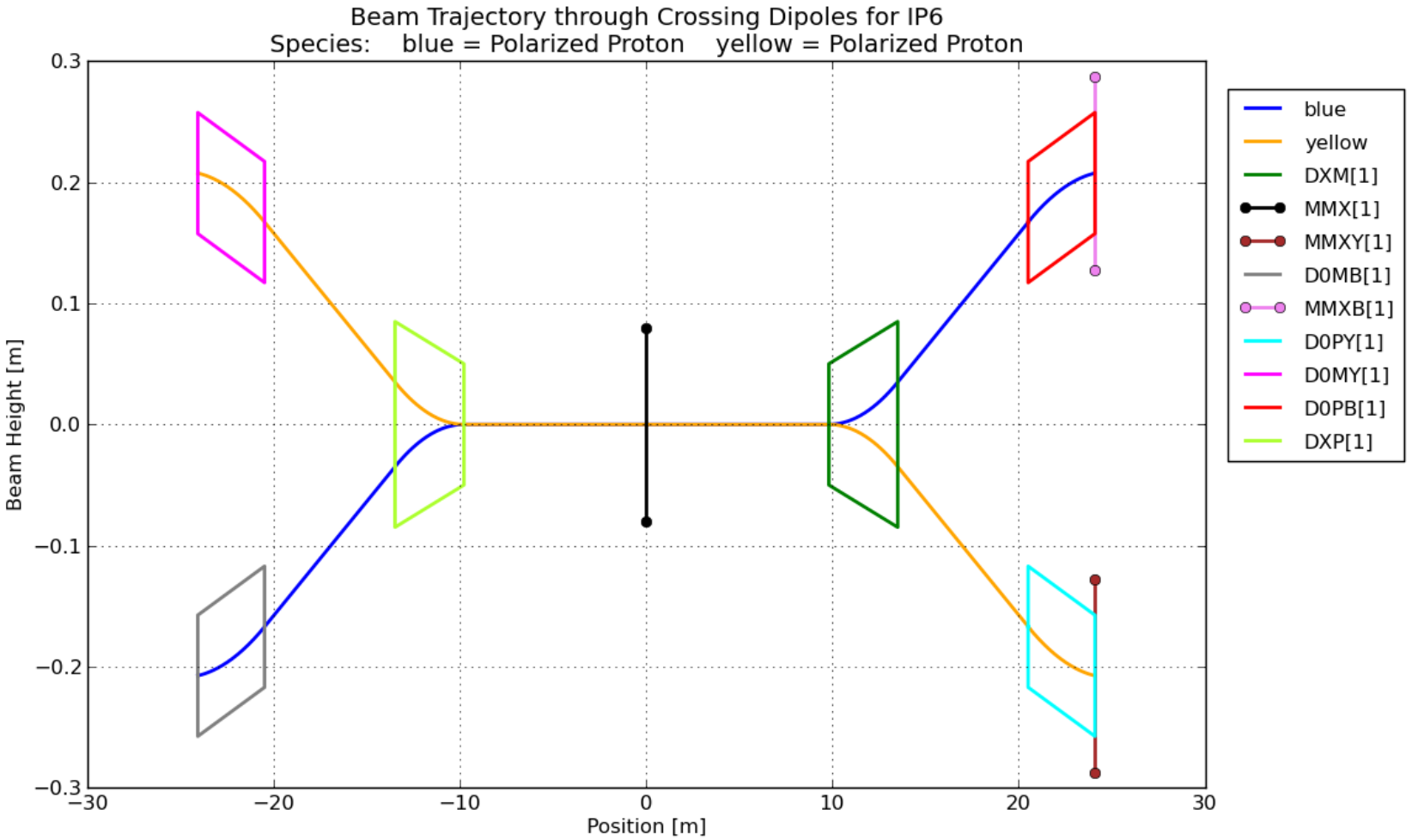
pA Collisions

- RHIC p-Au strategy
- Beam Crossing Geometry
- Beam Sizes
- Conclusion

pA Collisions

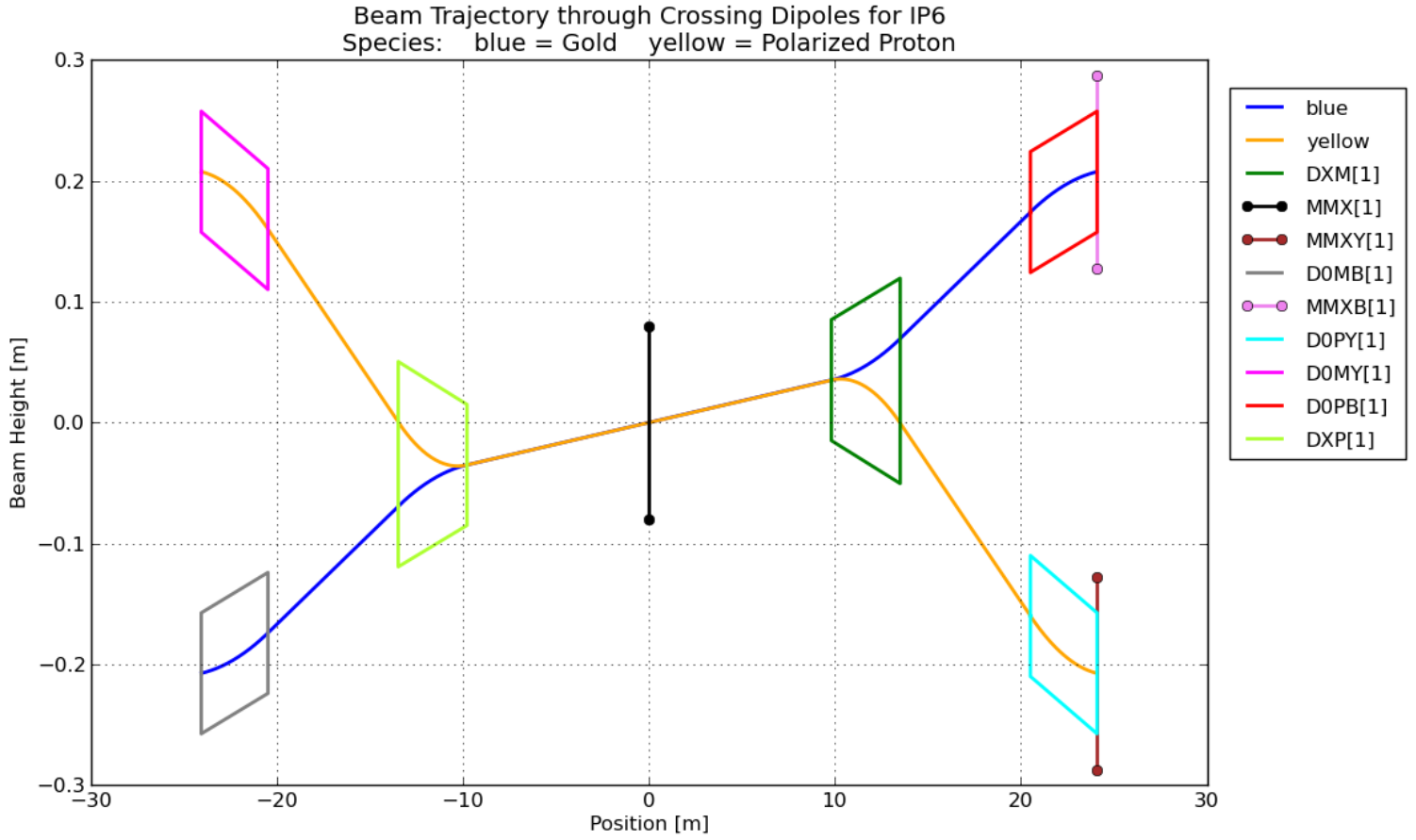
- Requires a large aperture in the DX magnet
  - Due to expense and field quality requirements, aperture was reduced
  - The strategy is to move the DX magnets for p-Au collisions
- Propose a plan to minimize the moving of the DX magnets
  - Gold in Blue ring, Protons in Yellow ring

Equal Species Geometry



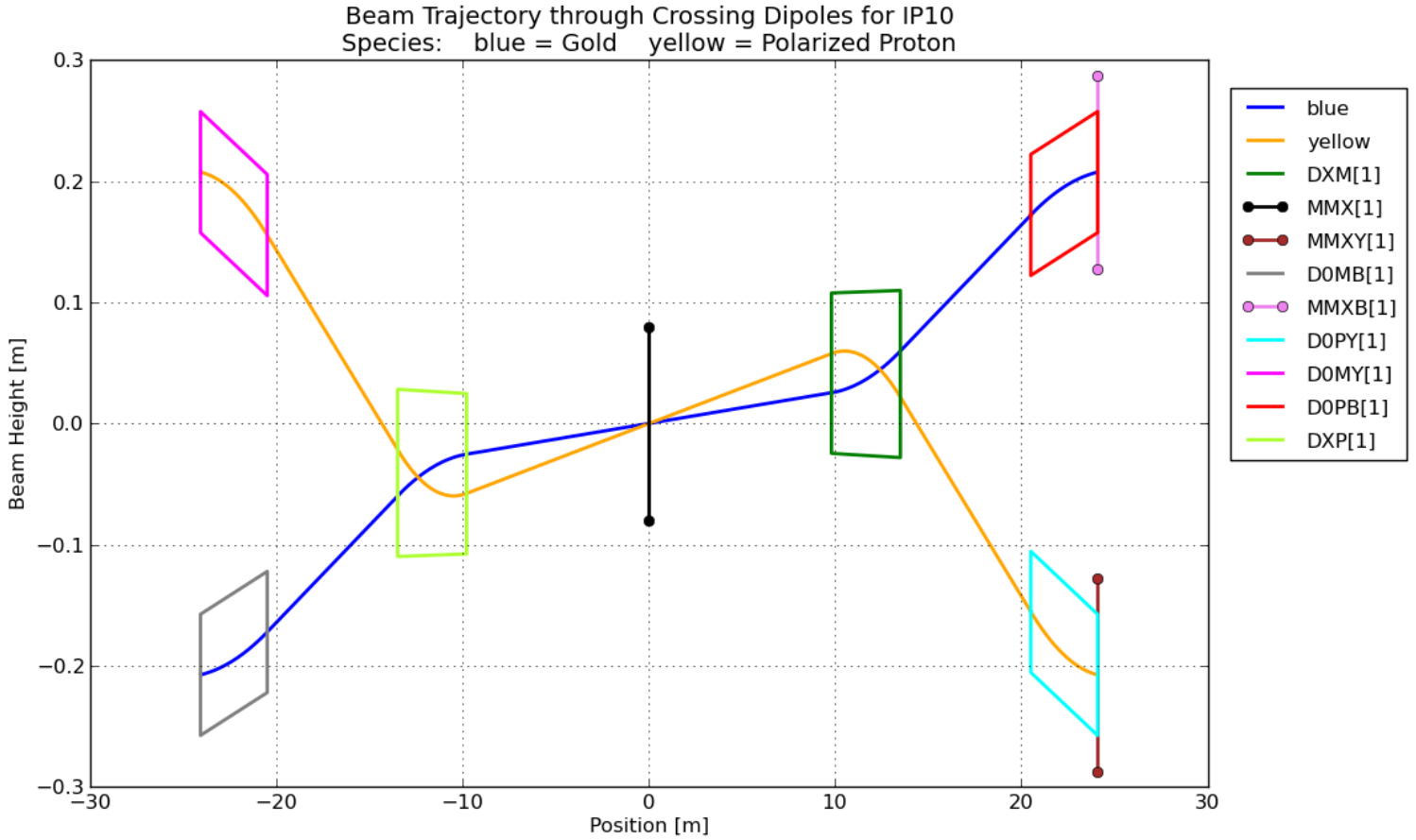
pA Collisions IP6 and IP8

The beam angles relative to the central axis is 3.58 *mrad*
Gold beam center is maximum of 69.362 *mm* from the DX magnet center



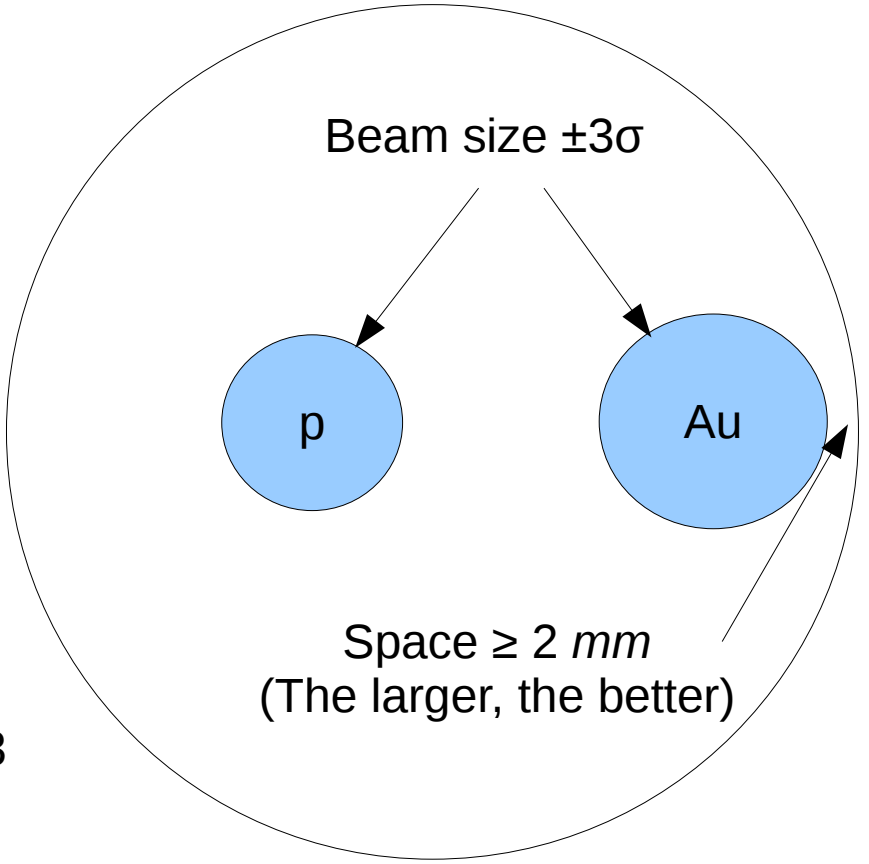
pA Collisions Non-colliding IPs

Crossing angle = -3.305 *mrad* minimizes the apertures in the non-colliding IPs
Beam center is maximum of 59.777 *mm* from DX magnet center



pA Collisions Beam Sizes

$$\sigma = \sqrt{\frac{(\frac{\epsilon_N}{\pi})(\beta^* + \frac{s^2}{\beta^*})}{6(\beta\gamma)}}$$



Store conditions:
Gold at Bρ = 831.763 *Tm* or (βY) = 107.391
Proton at Bρ = 358.647 *Tm* or (βY) = 114.593

DX magnet (radius = 68.326 *mm*)

pA Collisions Beam Sizes

Row	Species	Operation	ε_N/π	β^*	s	Bρ	(βγ)	σ	Center	Space
			[μm]	[m]		[T-m]		[mm]		
Non-Colliding IRs										
1	p	Injection	10	10	10.5	34.776	11.111	1.78	59.777	3.22
2	p	Injection	20	10	10.5	34.776	11.111	2.51	59.777	1.01
3	p	Store	10	4	10.5	358.647	114.593	0.68	59.777	6.52
4	p	Store	20	4	10.5	358.647	114.593	0.96	59.777	5.67
5	Au	Injection	10	10	13.5	86	11.104	2.06	59.777	2.37
6	Au	Injection	20	10	13.5	86	11.104	2.91	59.777	-0.18
9	Au	Store	10	4	13.5	831.763	107.391	0.88	59.777	5.92
10	Au	Store	20	4	13.5	831.763	107.391	1.24	59.777	4.83
11	Au	Store	40	4	13.5	831.763	107.391	1.75	59.777	3.29
Colliding IRs										
7	Au	Injection	10	10	13.5	86	11.104	2.06	69.362	-7.21
8	Au	Injection	20	10	13.5	86	11.104	2.91	69.362	-9.77
12	Au	Store	10	0.7	13.5	831.763	107.391	2.01	69.362	-7.07
13	Au	Store	20	0.7	13.5	831.763	107.391	2.85	69.362	-9.58
14	Au	Store	40	0.7	13.5	831.763	107.391	4.03	69.362	-13.11

Conclusion

- A collision strategy is proposed for moving only the IP6 and IP8 DX magnets by at minimum of 1 *cm*, better at 1.5 *cm*
  - Limit both beam sizes to 10π *mm-mrad* at injection
  - Reduce beam growth at store (stochastic cooling)
  - Aperture specs are tight
    - May have more difficulty to get stable beam
- This allows equal species to run as well